

# What Is a Cool Roof?

A cool roof is a roofing product with high solar reflectance and thermal emittance properties, which help reduce cooling loads by lowering roof temperatures on hot, sunny days. Solar reflectance and thermal emittance are properties of the roofing surface – not of insulation that may be used in conjunction with the roofing material.

Although often light in color, cool roofs come in a wide variety of colors ranging from white to black and including blues, grays, greens, oranges, browns, and tans. Cool roofs also are available in a variety of styles: shingle, shake, tile, membrane, and spray-on liquid coatings.



## Relevant Code Sections

2019 California Building Energy Efficiency Standards, Title 24, Part 6:

- [Section 10-113](#) – Rating and Labeling of Roofing Product Reflectance and Emittance
- [Section 110.8\(i\)](#) – Mandatory Requirements - Roofing Products Solar Reflectance and Thermal Emittance
- [Section 150.1\(c\)11](#) – Prescriptive Standards/Component Package for Low-Rise Residential Buildings, Roof Products
- [Section 150.2\(b\)11](#) – Energy Efficiency Standards for Alterations to Existing Low-Rise Residential Buildings, Prescriptive Approach, Roofs
- [Section 150.2\(b\)2](#) – Energy Efficiency Standards for Alterations to Existing Low-Rise Residential Buildings, Performance Approach:

## Relevant Compliance Forms

- [CF1R-ADD-01-E](#): Certificate of Compliance – Additions 1000 ft<sup>2</sup> or Less
- [CF1R-ALT-01-E](#): Certificate of Compliance – Residential Alterations (when HERS is triggered)
- [CF1R-ALT-05-E](#): Certificate of Compliance – Prescriptive Alterations (Simple projects that do not trigger HERS)
- [CF1R-ENV-04-E](#): Certificate of Compliance – Solar Reflectance Index Calculation Worksheet
- [CF1R-NCB-01-E](#): Certificate of Compliance – Prescriptive Newly Constructed Building
- [CF2R-ADD-02-E](#): Certificate of Installation – Prescriptive Residential Additions That Do Not Require HERS Field Verification
- [CF2R-ALT-05-E](#): Certificate of Installation – Prescriptive Alterations (Simple projects that do not trigger HERS)
- [CF2R-ENV-04-E](#): Certificate of Installation – Roofing and Radiant Barrier



# Code Triggers

The Title 24, Part 6 Building Energy Efficiency Standards (Energy Code) call for a cool roof when:

- The residential project is in an affected climate zone, which varies by roof slope (See Table 1)
- Replacing, recovering or recoating the exterior surface of existing residential roofs when >50% of the roof is replaced in specific climate zones

## Solar Reflectance Index

The SRI provides an alternative to meeting solar reflectance and thermal emittance requirements for cool roofs. SRI values are set to a normalized scale that incorporates the effects of both reflectance and thermal emittance.

Generally the higher the SRI, the better the roofing material's ability to reduce heat transfer into the building.

The SRI value is calculated based on:

- The aged solar reflectance and the thermal emittance of the roofing material
- The SRI worksheet also takes inputs for the roof slope

The SRI alternative is useful when a particular product exceeds the Energy Code requirement for either the aged solar reflectance or the thermal emittance, but does not meet both requirements. In this case the combination of the aged solar reflectance and the thermal emittance for the product may be sufficient to comply with the SRI requirement.

## Qualifying as a Cool Roof

To qualify as a cool roof under the Energy Code, the roofing material must:

- Have a Cool Roof Rating Council (CRRC) rating for reflectance and thermal emittance
- Meet the aged reflectance and thermal emittance – or Standard Reflectance Index (SRI) – values specified in the Energy Code (see below)

Roofing products must be tested and labeled by the CRRC. Being included in the ENERGY STAR® list for cool roofing materials is NOT sufficient to meet the Energy Code.

### Aged Solar Reflectance & Thermal Emittance

Specific aged solar reflectance and thermal emittance values must be met or exceeded for some climate zones and roof types (See Table 1). In areas where cool roofs are required, exceeding minimum requirements for solar reflectance and emittance will reduce cooling loads and may reduce building energy use.

Solar reflectance refers to a material's ability to reflect the sun's energy back into the atmosphere. Aged solar reflectance is the solar reflectance of the surface after three years, which typically is lower than the initial reflectance value. If the product is new and the aged solar reflectance value is unavailable, you can calculate the aged value using this formula:

$$\text{3-year Aged Solar Reflectance} = [ 0.2 + \beta(\rho_{\text{initial}} - 0.2) ]$$

- $\rho_{\text{initial}}$  = Initial Solar Reflectance  
 $\beta$  = Soiling Resistance by product type:
- Field-Applied Coating  $\beta = 0.65$
  - Other  $\beta = 0.70$

**Example:** If the initial solar reflectance value is 0.8 for a field-applied coating  
3-yr Aged Solar Reflectance =  $[ 0.2 + 0.65 (0.8 - 0.2) ]$   
=  $0.2 + 0.39$   
= 0.59

Thermal emittance provides a means of quantifying how much of the absorbed heat is rejected for a given material. The higher the thermal emittance value, the better (the more heat the roofing material emits back to the atmosphere).

**Note:** Aged solar reflectance and thermal emittance values noted in tables below must be derived from CRRC Rated Products Directory. If a roofing product is not CRRC certified, it is assumed to have the following default aged reflectance/emittance values for the Performance approach (CBECC-Res): 0.10/0.85.

The following information applies to conditioned (mechanically cooled or heated) residential buildings demonstrating compliance using the Prescriptive approach.



## Requirements

Roof Slope	Climate Zone	Either these reflectance and emittance values		Or this SRI value
		Min. 3-yr Aged Solar Reflectance	Min. Thermal Emittance	Min. SRI
Low-slope <sup>1</sup>	13 & 15	0.63	0.75	75
Steep-slope <sup>1</sup>	10 thru 15	0.20	0.75	16

1 Low-slope = Rise-to-run ratio of < 2:12 (lower than 9.5 degrees)  
Steep-slope = Rise-to-run ratio ≥ 2:12 (9.5 degrees or more)

Table 1 – Residential Cool Roof Requirements

## Exceptions... Cool Roof is NOT required if:

New Construction and Additions	
Any slope	The roof area is covered by building-integrated photovoltaic panels or building-integrated solar thermal panels
Any slope	Roof construction has a thermal mass over the roof membrane with a weight of at least 25 lb/ft <sup>2</sup>
Any slope	Roof is an addition ≤300 ft <sup>2</sup>
Alterations where >50% of the roof is replaced	
Any Slope	Building has no ducts in the attic
Steep slope	An air-space of 1.0 inch is provided between top of roof deck and bottom of roofing product
Steep slope	Existing ducts in the attic are insulated and sealed according to §150.1(c)9
Steep slope	Building has a radiant barrier in the attic meeting the requirements of §150.1(c) - this includes green roofs (roofs that are covered with vegetation) weighing at least 25 lb/ft <sup>2</sup> , though any portion of the roof not covered with vegetation will need to comply with cool roof requirements if not otherwise exempt
Steep slope	Building has at least R-38 ceiling insulation
Steep slope	Roofing product profile ratio of rise to width is at least 1:5 for ≥50% of the width of the roofing product
Steep slope	R-2 or greater insulation above the roof deck in Climate Zones 10-15
Low slope	The aged solar reflectance can be traded off with additional insulation added at the roof deck as per Table 150.2-B (See Table 3)

Table 2 – Exceptions

Aged Solar Reflectance	Roof Deck Insulation R-value
0.62 - 0.60	2
0.59 - 0.55	4
0.54 - 0.50	6
0.49 - 0.45	8
0.44 - 0.40	12
0.39 - 0.35	16
0.34 - 0.30	20
0.29 - 0.25	24

Table 3 – Low-Slope Alterations Tradeoff with Insulation from Table 150.2-B





# Forms – Which & When

In addition to a permit, you will need the following.

## During Design:

- **CF1R-NCB-01-E:** Prescriptive newly constructed building form
  - Roofing Products, Cool Roof (Part G, Page 3 of 7)
    - Completed and signed by the contractor or design professional
    - Submitted to the building department by the contractor or the homeowner
- **CF1R-ADD-01-E:** Certificate of Compliance – Additions 1000 ft<sup>2</sup> or Less
  - General information (Part A, Page 1 of 7)
  - Roofing Products (Cool Roof) (Part G, page 3 of 7)
  - Declaration Statement (Page 4 of 4)
    - Completed and signed by the contractor
    - Submitted to the building department by the contractor or the home owner
- **CF1R-ALT-01-E:** Certificate of Compliance – Residential Alterations (when HERS is triggered)
  - General information (Part A, Page 1 of 4)
  - Roofing Replacement (Part C, Page 1 of 4)
  - Declaration Statement (Page 4 of 4)
    - Completed and signed by the contractor
    - Submitted to the building department by the contractor or the home owner
- **CF1R-ALT-05-E:** Certificate of Compliance – Prescriptive Alterations (Simple projects that do not trigger HERS)
  - Completed and signed by the designer, installing contractor or homeowner
  - Submitted to the building department during permit application

**Why?:** To show compliance with the Energy Code for Cool Roof

**Notes:** Check with your local building department to determine if they have alternate documentation options.

- (Optional) **CF1R-ENV-04-E:** Certificate of Compliance – Solar Reflectance Index Calculation Worksheet
  - Completed and signed by the contractor
  - Submitted to the building department by the contractor or the home owner

**Why?:** To show compliance with Cool Roof Prescriptive requirements, where applicable

## During Construction:

- **CF2R-ENV-04-E:** Installation Certificate for Roofing
  - Radiant Barrier Information (page 1 of 3)
  - Description of Roofing Products (2 of 3)
  - Declaration Statement (Page 3 of 3)
    - Completed and signed by the installing contractor
    - Made available for final inspection by building department


- **CF2R-ADD-02-E:** Certificate of Installation – Prescriptive Residential Additions That Do Not Require HERS Field Verification
  - General information (Part A, Page 1 of 7)
  - Roofing Products (Cool Roof) – Additional Requirements (Part K, page 5 of 9)
  - Declaration Statement (Page 4 of 4)
    - Completed and signed by the contractor
    - Submitted to the building department by the contractor or the home owner
- **CF2R-ALT-05-E:** Certificate of Installation – Prescriptive Residential Alterations That Do Not Require HERS Field Verification
  - General information (Part A, Page 1 of 9)
  - Roof/Ceiling Insulation (Part B, Page 2 of 9)
  - Radiant Barrier (Part G, Page 4 of 9)
  - Required Vent Area (Part H, Page 4 of 9)
  - Roofing Products (Cool Roof) Installation Information (Part I, page 4 of 9)
  - Radiant Barrier and Attic Ventilation – Additional Requirements (Page 5 of 9)
  - Roofing Products (Cool Roof) Additional Requirements (Page 5 of 9)
  - Declaration Statement (Page 9 of 9)
    - Completed and signed by the installing contractor
    - Made available for final inspection by building department

**Why?:** To verify the field installation meets or exceeds the Energy Code

**Notes:** CRRC label(s) should be attached to the **CF2R-ENV-04-E** form

## Product Labeling per Section 10-113:

- For all roofs:
  - CRRC label specifying the initial and aged (“weathered”) solar reflectance and thermal emittance
- For liquid-applied roof coatings applied to low-sloped roofs:
  - CRRC label specifying the initial and aged (“weathered”) solar reflectance and thermal emittance
  - Label stating the product meets the ASTM requirements specified in [Section 110.8\(i\)4](#) of the Energy Code.
- Product labeling must be available for final inspection by building department.

		<b>Initial</b>	<b>Weathered</b>
	Solar Reflectance	0.20	Pending
	Thermal Emittance	0.75	Pending
	Rated Product ID Number	-----	
	Licensed Seller ID Number	-----	
	Classification	Production Line	
<small>Cool Roof Rating Council ratings are determined for a fixed set of conditions, and may not be appropriate for determining seasonal energy performance. The actual effect of solar reflectance and thermal emittance on building performance may vary.            Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.</small>			

# For More Information

## Primary Documents

- Energy Code Section 10-113 – Rating and Labeling of Roofing Product Reflectance and Emittance:  
[energycodeace.com/site/custom/public/reference-ace-2019/index.html#!Documents/10113ratingandlabelingofroofingproductreflectanceandemittance.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/index.html#!Documents/10113ratingandlabelingofroofingproductreflectanceandemittance.htm)
- Energy Code Section 110.8(i) - Mandatory Requirements - Roofing Products Solar Reflectance and Thermal Emittance:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1108mandatoryrequirementsforinsulationroofingproductsandr1.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1108mandatoryrequirementsforinsulationroofingproductsandr1.htm)
- Energy Code Section 150.1(c)11 – Prescriptive Standards/ Component Package for Low-Rise Residential Buildings, Roof Products:  
[energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1501performanceandprescriptivecomplianceapproachesforlowr.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/Documents/section1501performanceandprescriptivecomplianceapproachesforlowr.htm)
- Energy Code Section 150.2(b)11 – Energy Efficiency Standards for Alterations to Existing Low-Rise Residential Buildings, Prescriptive Approach, Roofs:  
[energycodeace.com/site/custom/public/reference-ace-2019/index.html#!Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/index.html#!Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm)
- Energy Code Section 150.2(b)2 - Energy Efficiency Standards for Alterations to Existing Low-Rise Residential Buildings, Performance Approach:  
[energycodeace.com/site/custom/public/reference-ace-2019/index.html#!Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm](http://energycodeace.com/site/custom/public/reference-ace-2019/index.html#!Documents/section1502energyefficiencystandardsforadditionsandalterationsto.htm)

## Compliance Forms

- Nonresidential Compliance Forms  
[energycodeace.com/ResidentialForms/2019](http://energycodeace.com/ResidentialForms/2019)

## Cool Roof Products and Specifications

- CRRC Rated Products Directory:  
[coolroofs.org/products/results](http://coolroofs.org/products/results)
  - Search for rated roofing products
- Solar Reflectance Index (SRI) calculator:  
[energy.ca.gov/2015publications/CEC-400-2015-032/appendices/forms/CF1R/2016-CF1R-ENV-04-E-CoolRoofAndSRIWorksheet.pdf](http://energy.ca.gov/2015publications/CEC-400-2015-032/appendices/forms/CF1R/2016-CF1R-ENV-04-E-CoolRoofAndSRIWorksheet.pdf)
  - Use to determine the SRI value for a specific product

## California Energy Commission Information & Services

- Energy Code Hotline: 1-800-772-3300 (Free) or [Title24@energy.ca.gov](mailto:Title24@energy.ca.gov)
- Online Resource Center:  
[energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center](http://energy.ca.gov/programs-and-topics/programs/building-energy-efficiency-standards/online-resource-center)
  - The Energy Commission’s main web portal for the Energy Code, including information, documents and historical information

## Additional Resources

- Energy Code Ace:  
[EnergyCodeAce.com](http://EnergyCodeAce.com)

An online “one-stop-shop” providing free resources and training to help appliance and building industry professionals decode and comply with Title 24, Part 6 and Title 20. The site is administered by California’s investor-owned utilities. Please register with the site and select an industry role for your profile in order to receive messages about all our free offerings!



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